Isolated 16-bit Analog Output Board for PCI Express
AO-1604LI-PE

* Specifications, color and design of the products are subject to change without notice.

This product is a PCI Express bus-compliant interface board used to provide an analog signal output, output function on a PC. AO-1604LI-PE features bus isolated 16-bit analog output 4 channels. Equipped with digital I/O and counter, this product is multifunction and bus isolated type that provides isolation between PC and external analog I/O circuit.   This product carries buffer memory for 1K of data, allowing sampling to be performed in a variety of trigger / clock conditions.

Windows/Linux driver and full-fledged data logger software "C-LOGGER" is bundled with this product.   Possible to be used as a data recording device for MATLAB and LabVIEW, with dedicated libraries.

* The contents in this document are subject to change without notice.
* Visit the CONTEC website to check the latest details in the document.
* The information in the data sheets is as of July 2022.

Features

Bus isolated high precision analog output 4 channels, each 4 channels for digital I/O, counter 1 channel
This product has analog output (10μsec [100KSPS], 16-bit, 4 channels), analog output control signal (Isolation TTL level 3 channels), digital I/O (4 channels each for Isolation TTL level), counter (32-bit, Isolation TTL level 1 channel).

Functions and connectors are compatible with PCI compatible board DAI16-4(LPCI)L
The functions same with PCI compatible board DAI16-4(LPCI)L are provided.   In addition, as there is compatibility in terms of connector shape and pin assignments, it is easy to migrate from the existing system.

Bus isolation between PC and external I/O signals by a digital isolator
Isolation between PC and external I/O circuit by a digital isolator improves noise tolerance.

The start/end of sampling can be controlled by software, an external trigger, etc.
You can select from software, an external trigger to control the start of sampling. You can select from completion of sampling for a specified number of sessions, an external trigger or software to control forcibly the end of sampling.   The sampling cycle can be selected from the internal clock or an external clock.

Safety design to adjust output voltage to 0V when power supply is turned on
To prevent the unstable voltage and the connected device of D/A converter from fault and malfunctions when the power supply is turned on, the circuit is designed to adjust output voltage of the analog output to 0V.

Equipped with buffer memory (1K data) that can be used in the FIFO or RING format
The analog output block contains buffer memory (1K data) that can be used in the FIFO or RING format.   This allows for background analog output that does not depend on the operation status of the software or PC.

Digital filter function included to prevent misdetection due to chattering on external signals
A digital filter is included to prevent misdetection due to chattering on the control signal (external trigger input signal, sampling clock input signal, etc.), digital input signal and counter input signal.
(Except from external clock input signal and counter gate signal)

Software-based calibration function
Calibration can be all performed by software.   Apart from the adjustment information prepared before shipment, additional adjustment information can be stored according to the use environment.

Data logger software, Windows/Linux compatible driver libraries are attached.
Using the bundled data logger software "C-LOGGER" allows you to display recorded signal data in graphs, save files without any special program.   In addition, the driver library API-PAC(W32) which makes it possible to create applications of Windows/Linux is provided.

MATLAB and LabVIEW is supported by a plug-in of dedicated library VI-DAQ.
Using the dedicated library MATLAB and VI-DAQ makes it possible to make a LabVIEW application.

Packing List

Board [AO-1604LI-PE] …1
First step guide … 1
Disk *1 [API-PAC(W32)] …1
Warranty Certificate …1
Serial Number Label …1

*1 The bundled disk contains the driver software and User's Guide.

List of Options

Shield Cable with 50-Pin Mini-Ribbon Connectors
at either Ends   :PCB50PS-0.5P (0.5m)
                                                       :PCB50PS-1.5P (1.5m)
Shield Cable with 50-Pin Mini-Ribbon Connector
at one End   :PCA50PS-0.5P (0.5m)
                                                       :PCA50PS-1.5P (1.5m)
Screw Terminal Unit (M3 x 50P)   :EPD-50A *1*2
BNC Terminal Unit
(for analog input 8ch)   :ATP-8L *1*3

*1   PCB50PS-0.5P or PCB50PS-1.5P optional cable is required separately.
*2   "Spring-up" type terminal is used to prevent terminal screws from falling off.
*3   Capable of using the analog input of up to 8ch, and analog output of up to 2ch.

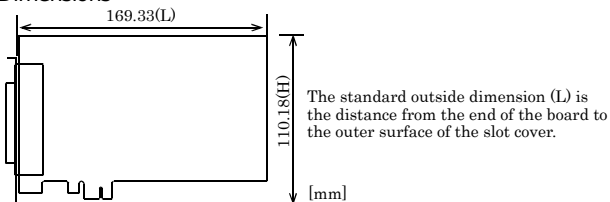* Check the CONTEC's Web site for more information on these options.

Specification

Item		Specifications
Analog output		
	Isolated specification	Bus-Isolated
	Number of output channels	4ch
	Output range	Bipolar ±10V
	Absolute max. output currency	±5mA
	Output impedance	1Ω or less
	Resolution	16bit
	Non-Linearity error *1	±5LSB
	Conversion speed	10μsec [100KSPS]*2
	Buffer memory	1k Word
	Conversion start trigger	Software / external trigger
	Conversion stop trigger	Number of sampling times / external trigger/software
	External start signal	Isolation TTL-level (Rising or falling edge can be selected by software) Digital filter (1μsec can be selected by software)
	External stop signal	Isolation TTL-level (Rising or falling edge can be selected by software) Digital filter (1μsec can be selected by software)
	External clock signal	Isolation TTL-level (Rising or falling edge can be selected by software)
Digital I/O		
	Number of input channels	Isolated input 4ch (TTL-level positive logic)
	Number of output channels	Isolated input 4ch (TTL-level positive logic)
Counter		
	Number of channels	1ch
	Counting system	Up count
	Max. count	FFFFFFFFh (Binary data,32bit)
	Number of external inputs	2 Isolation TTL-level (Gate/Up) Gate (positive logic/level), Up (Rising edge)
	Number of external outputs	1 Isolation TTL-level Count match output (positive logic, pulse output)
	Response frequency	1MHz (Max.)
Common section		
	I/O address	64 ports
	Interruption level	Errors and various factors, One interrupt request line as INTA
	Connector	10250-52A2JL[3M]
	Power consumption	3.3VDC 1500 mA (Max.)
	Operating condition	0 - 50℃, 10 - 90%RH (No condensation)
	Bus specification	PCI Express Base Specification Rev. 1.0a x1
	Dimension (mm)	169.33 (L) x 110.18(H)
	Weight	120 g
Certification		VCCI Class A, CE Marking (EMC Directive Class A, RoHS Directive), UKCA

*1 The non-linearity error means an error of approximately 0.1% occurs over the maximum range at 0℃ and 50℃ ambient temperature.
*2 SPS = Samplings Per Second.   The number of data that can be converted in one second is shown.

Dimensions

169.33(L)

110.18(H)

The standard outside dimension (L) is the distance from the end of the board to the outer surface of the slot cover.

[mm]

Support Software

Windows version of analog I/O driver API-AIO(WDM)
The API-AIO(WDM) is the Windows version driver library software that provides products in the form of Win32 API functions (DLL).   Various sample programs such as Visual Basic and Visual C++, etc and diagnostic program *1useful for checking operation is provided.

For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

  Linux version of analog I/O driver   API-AIO(LNX)
The API-AIO(LNX) is the Linux version driver software which provides device drivers (modules) by shared library and kernel version.   Various sample programs of gcc are provided.

For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

Data Acquisition library for MATLAB ML-DAQ
This is the library software which allows you to use our analog I/O device products on MATLAB by the MathWorks. Each function is offered in accordance with the interface which is integrated in MATLAB's Data Acquisition Toolbox.
For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

Data acquisition VI library for LabVIEW   VI-DAQ
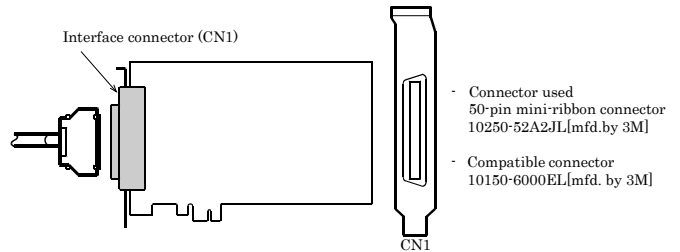This is a VI library to use in National Instruments LabVIEW.
VI-DAQ is created with a function form similar to that of LabVIEW's Data Acquisition VI, allowing you to use various devices without complicated settings.
For more details on the library and download of VI-DAQ, please visit the CONTEC's Web site.

How to connect the connectors

Connector shape
To connect an external device to this board, plug the cable from the device into the interface connector (CN1) shown below.

Interface connector (CN1)

CN1

- Connector used 50-pin mini-ribbon connector 10250-52A2JL[mfd.by 3M]
- Compatible connector 10150-6000EL[mfd. by 3M]

Connector Pin Assignment
Pin Assignments of AO-1604LI-PE Interface Connector (CN1)

Analog Output 02	AO 02	50		25	AO 00	Analog Output 00
Analog Ground (for AO)	AGND	49		24	AGND	Analog Ground (for AO)
Analog Output 03	AO 03	48		23	AO 01	Analog Output 01
Analog Ground (for AO)	AGND	47		22	AGND	Analog Ground (for AO)
Non Connect	N.C.	46		21	N.C.	Non Connect
Non Connect	N.C.	45		20	N.C.	Non Connect
Non Connect	N.C.	44		19	N.C.	Non Connect
Non Connect	N.C.	43		18	N.C.	Non Connect
Reserved	Reserved	42		17	Reserved	Reserved
Reserved	Reserved	41		16	Reserved	Reserved
Non Connect	N.C.	40		15	N.C.	Non Connect
Non Connect	N.C.	39		14	N.C.	Non Connect
Non Connect	N.C.	38		13	N.C.	Non Connect
Non Connect	N.C.	37		12	N.C.	Non Connect
AO External Start Trigger Input	AO START	36		11	N.C.	Non Connect
AO External Stop Trigger Input	AO STOP	35		10	N.C.	Non Connect
AO External Sampling Clock	AO EXCLK	34		9	N.C.	Non Connect
Digital Ground	DGND	33		8	DGND	Digital Ground
Digital Output 00	DO 00	32		7	DI 00	Digital Input 00
Digital Output 01	DO 01	31		6	DI 01	Digital Input 01
Digital Output 02	DO 02	30		5	DI 02	Digital Input 02
Digital Output 03	DO 03	29		4	DI 03	Digital Input 03
Digital Ground	DGND	28		3	DGND	Digital Ground
Counter UP Clock Input	CNT UPCLK	27		2	CNT GATE	Counter Gate Control
Reserved	Reserved	26		1	CNT OUT	Counter Output

|	
Analog Output00 - Analog Output03	Analog output signal. The numbers correspond to channel numbers.
Analog Ground	Common analog ground for analog I/O signals.
AO External Start Trigger Input	External trigger input for starting analog output sampling.
AO External Stop Trigger Input	External trigger input for stopping analog output sampling.
AO External Sampling Clock Input	External sampling clock input for analog output.
Digital Input00 - Digital Input03	Digital input signal.
Digital Output00 - Digital Output03	Digital output signal.
Counter Gate Control Input	Gate control input signal for counter.
Counter Up Clock Input	Count-up clock input signal for counter.
Counter Output	Counter output signal.
Digital Ground	Common digital ground for digital I/O signals, external trigger inputs, external sampling clock inputs, and counter I/O signals.
Reserved	Reserved pin.
N.C.	No connection to this pin.

CAUTION
- Do not connect any of the outputs and power outputs to the analog or digital ground. Neither connect outputs to each other.   Doing either can result in a fault.
- If analog and digital ground are shorted together, noise on the digital signals may affect the analog signals.   Accordingly, analog and digital ground should be separated.
- Leave "Reserved" pins unconnected.   Connecting these pins may cause a fault in the board.

Analog Output Signal Connection

This section shows how to connect the analog output signal by using a flat cable or a shielded cable.
The following figure shows an example of flat cable connection.
Connect the signal source and ground to the CN1 analog output.

Analog Output Connection (Flat Cable)
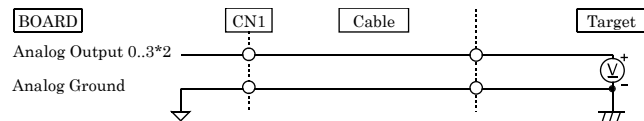
The following figure shows an example of shield cable connection. Use shielded cable if the distance between the signal source and board is long or if you want to provide better protection from noise.   For each analog input channel on CN1, connect the core wire to the signal line and connect the shielding to ground.

Analog Output Connection (Shield Cable)
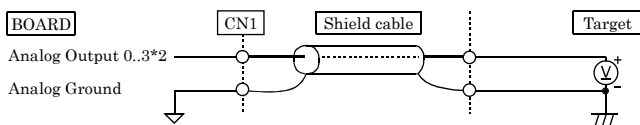
*2   The number of channels depends on each board.   The AO-1604LI-PE has four channels.

CAUTION
- When the power supply is turned on, the output voltage of all channels becomes 0V.
- If the board or the connected wire receives noise, or the distance between the board and the target is long, data may not be outputted properly.
- Do not short the analog output signal to analog ground, digital ground, and/or power line. Doing so may damage the board.
- Do not connect an analog output signal to any other analog output, either on the board or on an external device, as this may cause a fault on the board.
- Analog ground of CN1 is isolated from the ground in the PC.

Digital I/O signals, Counter signals and Control signals Connection

The following sections show examples of how to connect digital I/O signals, counter I/O signals, and other control I/O signals (external trigger input signals, sampling clock input signals, etc.).
All the digital I/O signals and control signals are TTL level signals.

Digital Input Connection
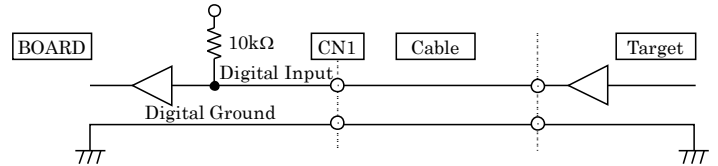

Digital Output Connection
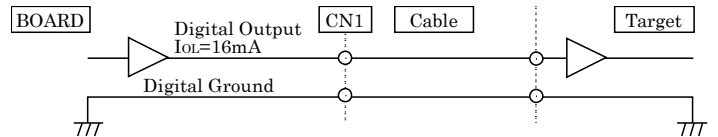
About the counter input control signal
Counter Gate Control Input (refer to the chapter 3 Connector Pin Assignment) acts as an input that validate or invalidate the input of an external clock for the counter.   This function enables the control of an external clock input for the counter.   The external clock for the counter is effective when input is "High", and invalid when input is "Low".   If unconnected, it is a pull-up in the board (card) and remains "High". Therefore the external clock for the counter is effective when the counter gate control input is not connected.

CAUTION
- Do not short the output signals to analog ground, digital ground, and/or power line.   Doing so may damage the board.
- Do not connect a digital output signal to any other digital output, either on the board or on an external device, as this may cause a fault on the board.
- Analog ground of CN1 is isolated from the ground in the PC.

Block Diagram
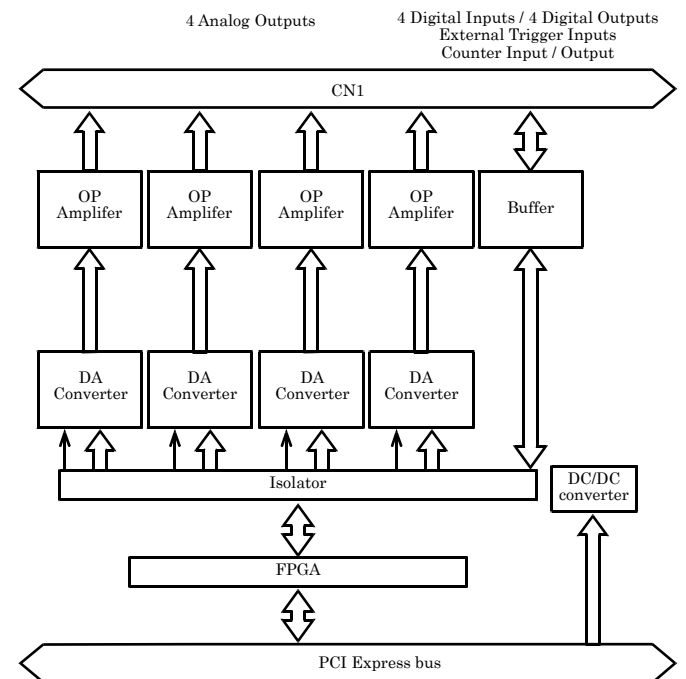
Difference from DAI16-4(LPCI)L

The functions same with conventional product of DAI16-4(LPCI)L are provided with the AO-1604LI-PE.   In addition, as there is compatibility in terms of connector shape and pin assignments, it is easy to migrate from the existing system.   So you can use the same operating procedures as DAI16-4(LPCI)L.

There are some differences in specifications as shown below.

	AO-1604LI-PE	DAI16-4(LPCI)L
Power consumption	+3.3VDC 1500 mA (Max.)	+5VDC 800mA (Max.)
Bus specification	PCI Express Base Specification Rev. 1.0a x1	PCI (32-bit, 33MHz, Universal key shapes supported)
Dimension (mm)	169.33(L) x 110.18(H)	121.69(L) x 63.41(H)
Weight	120g	65g